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Quest for Casimir repulsion between Chern-Simons surfaces

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Abstract

© 2018 American Physical Society. In this paper we critically reconsider the Casimir repulsion between surfaces that carry the Chern-Simons interaction (corresponding to the Hall-type conductivity). We present a derivation of the Lifshitz formula valid for arbitrary planar geometries and discuss its properties. This analysis allows us to resolve some contradictions in the previous literature. We compute the Casimir energy for two surfaces that have constant longitudinal and Hall conductivities. The repulsion is possible only if both surfaces have Hall conductivities of the same sign. However, there is a critical value of the longitudinal conductivity above which the repulsion disappears. We also consider a model where both parity odd and parity even terms in the conductivity are produced by the polarization tensor of surface modes. In contrast to the previous publications [L. Chen and S.-L. Wan, Phys. Rev. B 84, 075149 (2011)PRBMDO1098-012110.1103/PhysRevB.84.075149; Phys. Rev. B 85, 115102 (2012)PRBMDO1098-012110.1103/PhysRevB.85.115102], we include the parity anomaly term. This term ensures that the conductivities vanish for infinitely massive surface modes. We find that at least for a single mode, regardless of the sign and value of its mass, there is no Casimir repulsion.

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